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the total kinetic energy, the process of exchange by radiation is, on the whole, slow. Were, however, the translatory motion the direct cause of radiation, the exchanges between diathermous bodies must apparently be nearly instantaneous.

(To be continued.)

OYSTER-CULTURE IN HOLLAND.

THE first of a series of papers on the European oyster and oyster industry of the Eastern Schelde¹ has just been published by Mr. P. P. C. Hoek, secretary of the commission of the zoölogical station of the zoölogical society of Holland. It is to be followed by a series of papers gotten up in similar style by eminent specialists: 1°. On the embryology of the European oyster; 2°. On its food, parasites, and commensals; 3°. A review of the fauna of the Eastern Schelde; 4°. A report on the physical conditions presented by the Eastern Schelde; 5°. A report on experiments made to determine the conditions under which the fixation of the larval oyster occurs.

In this report the author devotes a short chapter to a discussion of the classical allusions to the animal, from the Homeric period to the time of Oppian. Then comes a chapter on the references to the oyster found in Conrad Gesner's *Historia animalium*, lib. iv., edition of 1620; followed by an exhaustive bibliography of ninety pages, in which the works of upwards of two hundred and seventy-five authors are mentioned, covering the period from 1685 to 1883, or nearly two hundred years.

Then follows a paper on the organs of generation of the oyster, by Mr. Hoek, accompanied by an excellent series of lithographic plates representing microscopic transverse sections of the European oyster. The text of this is in Dutch and French on alternate pages. A chapter is devoted to a historical résumé of our knowledge of the anatomy of the generative organs, and is succeeded by an account of the author's investigations.

A second part is devoted to the physiology of reproduction, and is preceded by an historical sketch of this part of the subject, from the time of Leeuwenhoek to the present. The author gives a summary of his results, both anatomical and physiological, as follows: the genital gland is not a compact organ: it lies on the surface of the body of the animal under a thin layer of connective tissue (mantle), below which branched ducts spread out over the reproductive organ, connected on the inner side with the reproductive follicles, which have a generally vertical direction to the surface of the visceral mass, and which anastomose with each other. The generative products develop on the walls of the follicles, the ova and spermatozoa being formed side by side. The author

inclines to the belief that the generative products are developed from the ectoderm. The ova are developed from single epithelial cells adherent to the wall of the parent follicle, while the mother-cells of the characteristic masses of spermatozoa are only portions of such cells. The organ of Bojanus does not have a compact structure as in other lamellibranchs, but is composed of a mass of ducts and blind sacs, which forms a thin flat plate of considerable extent. Contrary to what may be noted of the reproductive glands, the organ of Bojanus extends somewhat into the mantle. The ducts and cavities of the organ of Bojanus pour their contents into a longitudinal cavity, — the urinary chamber, — the walls of which are also excretory in function, and open outwardly by way of a short urinary canal. The external orifice of the renal organ opens into the same cleft as the genital duct, a little behind the latter, but they do not actually join. These genito-urinary sinuses lie below the adductor on either side of the ventral process of the body-mass. A reno-pericardiac canal connects the urinary chamber with the pericardiac cavity. It is probable that the auricles of the heart also exercise an excretory function.

An oyster which has fry in the branchiae is the parent of the same. At the moment of emission from the ovaries, not only have the ova been fertilized, but they have also passed through the first stages of segmentation. The sperm necessary for fecundation does not come from the same parent. The water which flows over other oysters in the vicinity charged with sperm, which they have set free, is carried into the mantle-cavity of egg-bearing individuals, and into their genital ducts and their branches. The oysters of the Eastern Schelde are two years old before they have brood; they are most prolific at the age of four or five years. There are more sperm-bearing oysters in the Eastern Schelde than egg-bearing ones. All of the mature eggs are laid at once; the production of sperm is probably continued for a longer time. In every instance that was investigated, the production and emission of ova is followed by a period during which no sperm is produced. A large proportion of the spat found fixed on the banks in the Eastern Schelde was probably not derived from the oysters inhabiting the cultivated beds. Culture appears to act injuriously upon the reproductive powers of the animal. In old oysters the liver is much more developed than in younger ones. This greater development of the liver is dependent upon the less marked development of the reproductive organs.

J. A. RYDER.

GALTON'S HUMAN FACULTY.

Inquiries into human faculty and its development.
By FRANCIS GALTON, F.R.S. New York, Macmillan, 1883. 12 + 380 p., 6 pl. 8°.

MR. GALTON'S researches have for a good while attracted the attention of English and American students of psychology and anthropology. As they are here brought together,

¹ *Verslag omtrent onderzoekingen op de oester en de oester-cultuur betrekking hebbende. Aflevering i.* (With title in French: *Rapport sur les recherches concernant l'huître et l'ostréiculture. Livraison i.*) Leiden, E. J. Brill, 1883. 253 p., 5 lithographic plates. 8°.

the practical purpose of their author is impressed upon us more clearly than ever. Mr. Galton means to introduce to our notice new aspects of the study of human character. He wishes to make this study more exact and scientific by founding it upon detailed investigations of facts previously neglected; and he proposes to offer the results as useful for a future science or art of eugenics, which shall teach the human race how to breed so that its best stock shall be preserved and improved, and its worst stock gradually eliminated. This seemingly utopian end is to be gradually approached by the formation of a public sentiment that shall encourage a new sort of family pride and exclusiveness; namely, when eugenic science has taught us what are the most useful human qualities, what their accompanying marks, what qualities are best transmitted to posterity, and what are the conditions that favor such transmission, then people otherwise not known to fame will be able, by a proper study of their family history, to discover their inherited wealth of valuable qualities, and their resulting eugenic rank; and such persons will be respected by an enlightened public according to their rank. People who rank high in the eugenic scale will be unwilling to contaminate their stock by unions with persons much lower in the scale, and their feelings in this matter will be appreciated. Thus marriages will become less blind, and civilization will progress faster.

That Mr. Galton's researches will be of much immediate use to young people about to marry, no truthful reviewer can promise; but to the psychologist, at least, they are in their present condition both attractive and useful; and, for the rest, it is much for Mr. Galton merely to have suggested, more definitely than Plato was able to do, that there ought to be, and some day may be, a real art of eugenics, which may be of practical importance for mankind. Just yet, neither Mr. Galton nor any one else can hope to do much more than to insist that the best parents may be expected to produce the best children; but there are many ways of insisting. Mr. Galton's most important contribution to this practical aspect of the subject lies in the facts that he has collected to give new importance to the matter by proving the vast predominance in ordinary cases of the influences of nature over those of nurture. Nature means for Mr. Galton the sum of all the inherited qualities of the individual, while nurture stands for the educating influences of the environment. In case of twins, Mr. Galton collects facts to show that

in one strongly marked class of such persons the resemblance between the twins is very strong from the outset, and then often extends through life to the smallest possible matters of physical and mental condition, even when the twins live far apart. But in other cases, which form a second equally marked class, the twins, contrasting somewhat strongly from the outset, never are brought nearer to likeness, notwithstanding all the similarity of the circumstances of their nurture and training. Thus, when the physiological conditions of their origin give them like nature, difference of nurture does not prevent very striking similarity throughout life; while, where the conditions of origin favor unlikeness, likeness of nurture goes but a little way to overcome the contrast. A similar result is indicated, according to Mr. Galton, by our experience with races of animals, some of which seem by nature disposed to domestication, while the stubborn nature of others resists the advantages of any nurture, so that they remain wild, however much we may try to tame them. From whatever side, then, the matter is viewed, nature seems superior in its persistence to the forces of nurture that opposed this persistence; and, if we want human stock to grow better through voluntary effort, we must undertake to study and improve pre-natal and ancestral influences yet more than we try to better the influences of education.

This, then, is Mr. Galton's most significant practical result. His researches upon various problems of the science of character, that have not yet been long enough studied to have much immediate practical significance, cannot easily be summed up in one short notice. The psychologist is most interested in his researches on mental imagery and on association of ideas. Mr. Galton is of the opinion that introspection can be made a more exact science than psychologists have previously found it. And so, indeed, it can be, no doubt, at least when it is limited to the lowest orders of mental facts. Here introspection is greatly aided by plain and simple questions. Ask a man to tell you all he can about what now goes on in his mind, and he will answer as wildly as you could wish; but ask him to call up in mind the picture of his hat or of his house, or to tell you whether in some concrete instance he can vividly remember musical harmony as distinct from melody, and most honest men can then answer intelligibly and usefully. It is Mr. Galton's service to have shown how much can be done by thus systematizing and simplifying the method of introspection, so that people who are

not psychologists may be able to furnish to the psychologist important and trustworthy data.

We do not remember that our author is quite plain in defining one of the safeguards needed to make this method useful. He says, in describing his researches into mental imagery (p. 87), "The conformity of replies from so many different sources, which was clear from the first, the fact of their apparent trustworthiness being on the whole much increased by cross-examination, and the evident effort made to give accurate answers, have convinced me that it is a much easier matter than I had anticipated, to obtain trustworthy replies to psychological questions. Many persons, especially women and intelligent children, take pleasure in introspection, and strive their very best to explain their mental processes. I think that a delight in self-dissection must be a very strong ingredient in the pleasure that many are said to take in confessing themselves to parish priests." But there is an obvious moral from all this. The method, with its questions and cross-questions, with its interested subjects and their pleasure in confessing themselves, is indeed fruitful; but the outcome must be controlled by the maxim that the subject's statements, when he is not himself an expert, must be trusted implicitly only when they are out of relation to any preconceived theory of his own about his mind, and equally out of relation to any popular prejudice or superstition that could influence him. Generally Mr. Galton seems to follow this maxim without explicitly recognizing it. The simplicity of his questions is itself a security. If you ask about one's mental picture of his breakfast-table or of his hat, you can be tolerably sure that he has no prejudices or superstitions that will affect his answer. But it is another thing, in case one is inquiring about the 'visions of sane persons,' and mentions some great man, say Napoleon, who is declared by some one to have had visions of his 'star,' and to have boasted thereof. Here such evidence as can be got would be worthless, even if the great man in question were not a notorious liar. For superstition, once for all, attributes stars to great men; and, when a story exactly corresponds to a known and wide-spread superstition, we may usually disregard the story save for the purposes of folk-lore. Yet, on p. 176, Mr. Galton makes a story of this sort the basis of reflections that of course may possibly be true; so that his caution is not quite perfect.

In fact, we should be disposed to apply the maxim just stated yet more carefully; namely, if the subject shows an uncommon visualizing power, he is both instructive and dangerous, and ought to be treated very tenderly. He can furnish many facts, but his replies are by so much the more apt to be influenced by some theory of his own. Accustomed all his life to his vivid imagery; very possibly a member of a family several of whom are uncommonly gifted in this respect; accustomed, therefore, to notice and talk about his power, and perhaps to boast of it, — he may have formed already some vain-glorious idea of what he can do or ought to do; and, when you set him at the task of talking about himself, you must be careful how you accept all that it may occur to him to say. A brief experience with one such subject as we have just described has convinced us that serious danger would arise from applying Mr. Galton's method to him without great care. And if we intended to publish any of his experiences, we should confine him strictly to commonplaces, should not publish his stories of what he used to see when a child, and should not introduce any thing that he connected with 'elevated spiritual experiences,' or with any other artistic excellence of which he seemed to feel proud. We fear that some of Mr. Galton's subjects needed more such watching. In fine, though Mr. Galton's researches on mental imagery, since their first publication in the form of memoirs, have greatly helped introspective psychology, no one, doubtless, would fear or deplore more than himself any misuse of them that should tend once again towards the mythological. Our suggestion is intended to help to ward off such a sad result, which, for the followers whom Mr. Galton is certain to have, might not be very far off. What might not our author have to mourn over, if 'psychological associations' were to become fashionable in country towns, and were to produce acres of manuscript or printed proceedings containing elevated spiritual visualizing experiences by old maids and semi-spiritualistic reformers? Yet, in these days of popular science and associations, who knows what Mr. Galton's pleasing way of speech might not produce, if he does not add to every new chapter of facts a note strenuously insisting that the exact and cautious methods that are commonplaces for him should be studied and followed by every ambitious one that would do likewise, however simple the subject-matter investigated may seem to be?

Mr. Galton can claim especial credit for his

investigations into visualized number-forms. Here the nature of the facts is the best guaranty of their general accuracy. They have generally been unknown, save to the subjects; they are not things of which people are apt to boast; their psychological significance is far greater than their popular interest; they have nothing of the elevated or of the spiritual about them; the research is quite new. All this secures the substantial correctness of the results, though, plainly, further accurate research will become harder when Mr. Galton's facts become more popularly known.

One general result that Mr. Galton seems to have established is, that growth in the power of abstract thought is opposed to the free development of the visualizing faculty. Scientific men have, as a rule, less vivid imagery than persons of less abstract habits of mind. Adults visualize less clearly than children. But this loss of visualizing power does not signify, he tells us, loss of clear memory of details. "Men who declare themselves entirely deficient in the power of seeing mental pictures can, nevertheless, give lifelike descriptions of what they have seen." Again: "it is a mistake to suppose that sharp sight is accompanied by clear visual memory." Yet more: "the visualizing and the identifying powers are by no means necessarily combined." Thus our author tells us that one distinguished subject is good at recognizing faces, but cannot visualize them at all. All these facts, and many others, seem to us to point to a result that Mr. Galton sometimes approaches, but does not distinctly formulate. On the contrary, in one place he says something directly opposed to it. "A visual image," he says (p. 113), "is the most perfect form of mental representation, wherever the shape, position, and relations of objects in space are concerned." And he thinks that mere laziness is responsible for the common starvation of this faculty; but, if this were so, it is hard to see how a healthy mental organism should, in the course of its normal development, generally tend to outgrow the visualizing faculty. 'The most perfect form of mental representation' for any purpose will not be the one that we should, as evolutionists, expect to find growing naturally less as the mind devotes itself more to that purpose; yet who are more concerned with the exact relations of things in space than workers in the details of descriptive natural science? And they, we are told, are apt to lack the faculty in question. The statement just quoted seems, then, to lack probability, and to be against the main result

to which, as we have said, all these researches seem to lead.

This result, we think, is that the clearest memory, in the long-run, tends to be the memory of acts, and not of the content of a sensation apart from its immediate relation to an action. This seems reasonable from the point of view of evolution. The life of an animal consists in doing what seems best under the circumstances; and the seeming is determined by instinct or individual experience, coupled with immediate sensation. All, then, that sensations mean for the animal, is summed up in saying that the sensation is useful as the sign of the need of a certain kind of action. The association of a given kind of sensation with a given kind of action results from individual or ancestral experience; but, in forming this association, not the whole of an experience need be remembered, but only so much as shall serve as a sign of a given sort of action. The mouse, even if it fled from the cat, not by instinct, but voluntarily, would still not need to visualize cats, but only to remember so much of the sensations aroused by a cat's presence as should suffice to arouse the right action.

On the other hand, if a given action is to be not automatic, but voluntary, the action must be conceivable clearly and in detail. If this is so, it will follow that the memory for ideas connected with muscular sensations, and so for actions, both bodily and intellectual, would not merely be capable of substitution for visualized images, but would normally tend to be so substituted. In fact, if a visualized image were the 'most perfect form of mental representation' for space relations, then geometrical reflection and definition would be a useless amusement in all cases of small objects. The other facts noted above, such as the relative power to identify without being able to visualize, seem to us capable of explanation in a similar fashion, by the relative preponderance of the memory for actions, and consequently of relations (which we know by virtue of our own bodily and mental actions), over the memory of the contents of bare sensation.

But we have said nothing of Mr. Galton's composite photographs, of his researches on association, or of the many other topics that render his book not only very amusing, but especially instructive, as showing how what in the hands of another man would be mere dilettanteism becomes in the hands of the master a very valuable series of contributions to science. And with these suggestions we must leave a very pleasant topic.